
Project 21303-15

**Swimmersive Co. dba Zygo
Zygo Coach**

**Wireless Certification Report
Wireless Microphone (VHF) Section**

Prepared for:

Swimmersive
16854 Mooncrest Dr
Encino, CA 91436

By

Professional Testing (EMI), Inc.
1601 North A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

29 Apr 2020

Reviewed by

A blue ink signature of Shakil Murad, featuring a stylized 'S' and 'M'.

Shakil Murad
Lead EMC Engineer

Written by

A black ink signature of Eric Lifsey, featuring a stylized 'E' and 'L'.

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
Draft 01	Draft for review.	25 Mar 2020
Final 02		12 May 2020
Final 03	Revised power as EIRP with antenna gain included.	3 Jun 2020
Final 04	Corrected citation of RSS-210 issue from 9 to 10.	3 Jun 2020

Errata:

Any reference to Coach applies to the model ZY100.

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Compliance Certificate

FCC MRA Designation Number: US5270 NVLAP Accreditation Number: 200062-0

Applicant	Device & Test Identification
Swimmersive Co. dba Zygo 16854 Mooncrest Dr Encino, CA 91436 Certificate Date: 29 Apr 2020	FCC ID: 2APZQ-ZYGO Industry Canada ID: 23961-ZYGO Model(s): ZY-100 Laboratory Project ID: 21303-15

The device named above was tested utilizing the following documents and found to be in compliance with the required criteria:

Requirement	Reference	Detail
FCC 47 CFR Part 15 C	15.236	47 CFR § 15.236 - Operation of wireless microphones in the bands 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-698 MHz. [And by reference ETSI EN 300 422-1 V1.4.2 (2011-08)]
FCC 47 CFR Part 15 C	15.236	Radiated emission limits; general requirements.
FCC 47 CFR Part 15 C	15.205	Restricted Bands of Operation
KDB 558074 D01	DR01	DTS Measurement Guidance v03r02
KDB 412172	D01	Guidelines for Determining the ERP and EIRP of an RF Transmitting System
OET Bulletin 65*	Edition 97-01, and Supplement C, Ed. 01-01	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
RSS-210	Issue 10	Annex G - Low-Power Radio Apparatus Operating in the Television Bands
RSS-Gen	Issue 5	General Requirements and Information for the Certification of Radio Apparatus
RSS-102	Issue 5	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

*MPE is reported separately from this document. **Corresponding RSS references are listed in the body of the report.

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above requirements and test procedures have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

Eric Lifsey
EMC Engineer

This report has been reviewed and accepted by the Applicant. The undersigned is responsible for ensuring that this device will continue to comply with the requirements listed above.

Representative of Applicant

1.0 Introduction

1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of the United States and Canada.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing.

1.2 EUT Description

Table 1.2.1: Equipment Under Test		
Manufacturer / Model	Serial #	Description
Swimmersive Model: ZY100	none	Wireless microphone transmitter.

Table 1.2.2: Support Equipment		
Manufacturer / Model	Serial #	Description
None		

This device is a hand-held remote wireless microphone use in training aquatic athletes by sending the coach's instructions, or other recorded audio, over the air (VHF) to headset receivers worn by the athletes.

This report concerns the wireless microphone transmitter.

The Bluetooth transmitter (subject to FCC 15.247) as contained in the EUT is reported separately.

This device is powered by an internal 3.7 V Li-Ion battery that is recharged on a cradle then via cable to a USB power source.

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations. Antenna connectors were added to the test samples only to allow conducted measurements.

1.4 Modifications to Equipment

None.

1.5 Test Site

Measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RSS-GEN, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located at 11400 Burnet Road, Austin, Texas 78758, while the main office is located at 1601 North A.W. Grimes Boulevard, Suite B, Round Rock, Texas, 78665.

1.6 Radiated Measurements

Table 1.6 1 Measurement Corrections	
Parameter	From Sums Of
Radiated Field Strength	Raw Measured Level + Antenna Factor + Cable Losses – Amplifier Gain
Conducted Antenna Port	Raw Measured Level + Attenuator Factor + Cable Losses
Conducted Mains Port	Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses

Additionally, measurement distance extrapolation factors (such as $1/d$ above 30 MHz) are applied and documented where used.

1.7 Applicable Documents and Clauses

Table 1.7.1: Applicable Documents	
Document	Title
47 CFR	Part 15 – Radio Frequency Devices Subpart C - Intentional Radiators
RSS-210 Issue 10 Annex G	Low-Power Radio Apparatus Operating in the Television Bands
ETSI EN 300 422-1 V1.4.2 (2011-08)	Electromagnetic compatibility and Radio spectrum Matters (ERM); Wireless microphones in the 25 MHz to 3 GHz frequency range; Part 1: Technical characteristics and methods of measurement European Standard
RSS-Gen Issue 5	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.10:2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

2.0 Fundamental Power

2.1 Test Procedure

Peak power is measured using the conducted method at the antenna port.

2.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.236 // RSS-210 Annex G.3.1	EIRP Fundamental Power 50 mW -50% to +20% of declared power	12 Dec 2019

2.3 Test Results, Peak Power

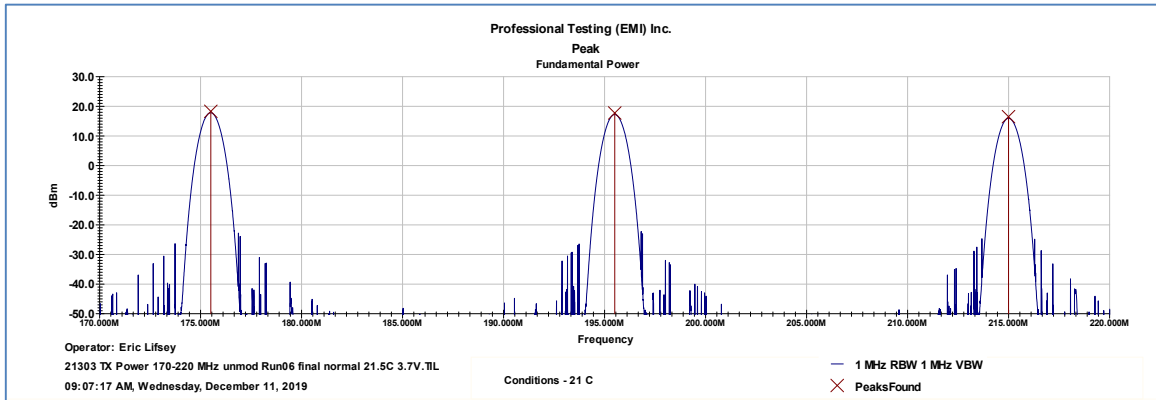
Table 2.3.1 Power, Peak, Measured Conducted, Unmodulated					
Frequency MHz	Normal Condition dBm (mW)	Extreme -20 C, 3.3 V dBm (mW)	Extreme -20 C, 3.7V dBm (mW)	Extreme 55 C, 3.3 V dBm (mW)	Extreme 55C, 3.7 V dBm (mW)
175.506	18.3 (67.6)	18.0 (63.1)	18.0 (63.1)	17.5 (56.2)	17.5 (56.2)
195.500	17.7 (58.9)	17.4 (55.0)	17.4 (55.0)	16.9 (49.0)	16.9 (49.0)
214.994	16.5 (44.7)	15.9 (31.6)	15.9 (31.6)	15.5 (35.5)	15.6 (36.3)

Measured in 1 MHz RBW, 1 MHz VBW.

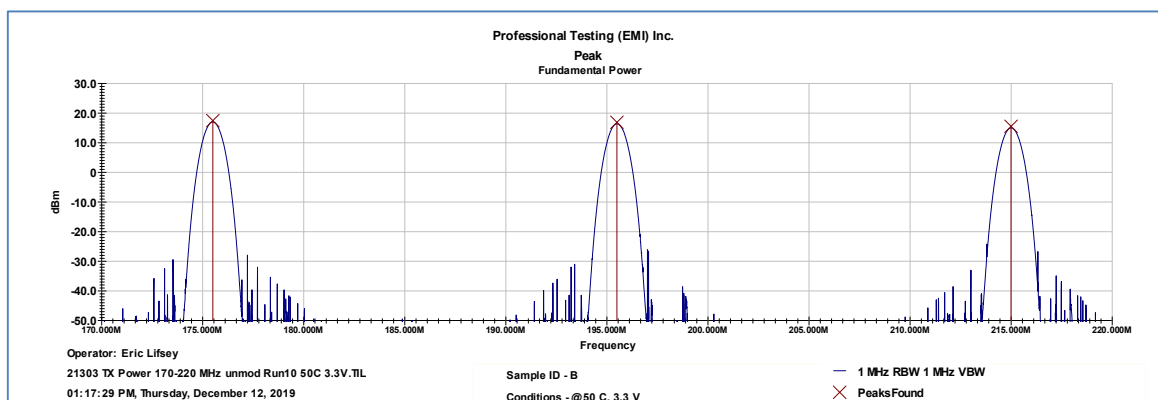
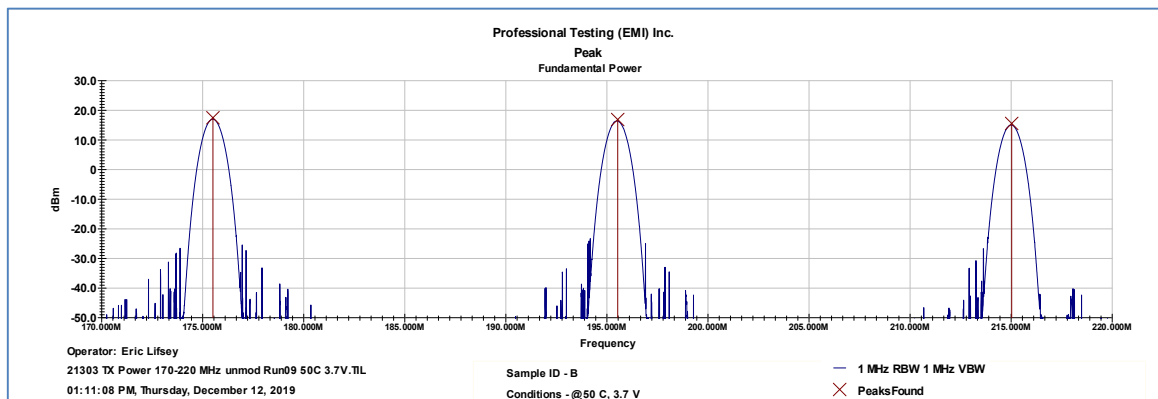
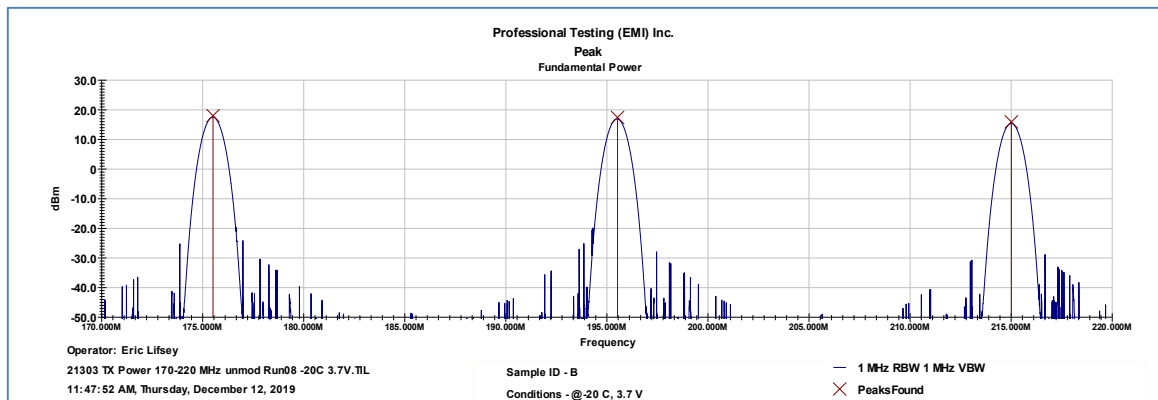
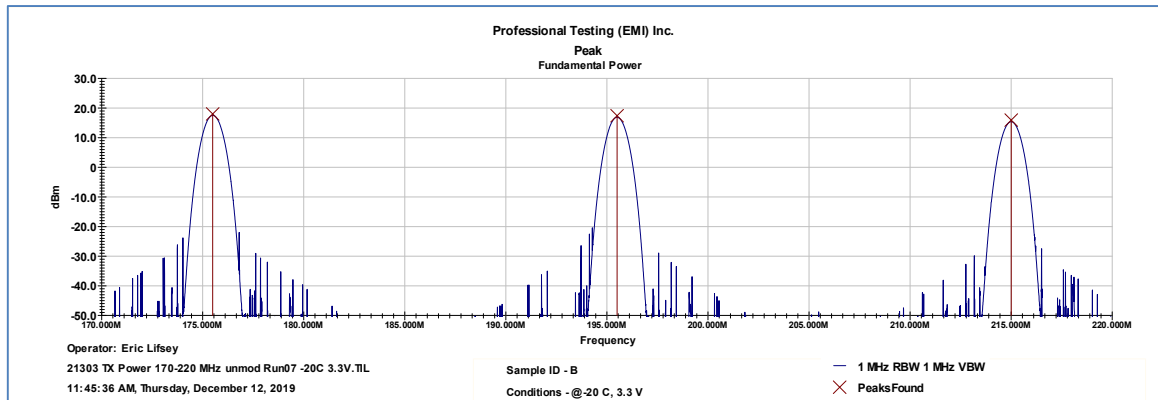
Table 2.3.2 EIRP Power			
Declared: 16 mW			
Limits: +20% = 19.2 mW, -50% = 8.0 mW			
Frequency MHz	Highest Measured Conducted Antenna Port Power dBm (mW)	Antenna Gain dBi	EIRP Power dBm (mW)
175.506	18.3 (67.6)	-5.5	12.8 (19.1)
195.500	17.7 (58.9)	-5.5	12.2 (16.6)
214.994	16.5 (44.7)	-5.5	11.0 (12.6)

The EUT satisfied the requirement.

2.3.1 Normal Conditions



2.3.2 Extreme Conditions



3.0 Frequency Stability

3.1 Test Procedure

Frequency is measured with EUT acclimated to temperature and operating voltage extremes.

3.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.236 // RSS-210 Annex G.3.1	Frequency Stability +/- 0.005% or +/- 8.77 kHz	12 Dec 2019

3.3 Test Results

The EUT satisfied the requirements.

Table 3.3.1 Frequency Stability in MHz Measured in 100 Hz RBW				
Temperature	Voltage	Bottom Channel 175.506	Middle Channel 195.500	Top Channel 214.994
-20 C	3.3 V	175.499930	195.500050	215.000035
-20 C	3.7 V	175.499950	195.499989	215.000037
20 C	3.7 V	175.499508	195.499471	214.999333
50 C	3.7 V	175.498356	195.498187	214.997994
50 C	3.3 V	175.498411	195.498161	214.998073
Maximum Error:		-7.644 kHz	-1.839 kHz	+6.037 kHz

4.0 Necessary Bandwidth Mask

4.1 Test Procedure

Bandwidth is measured by conducted means. A recording of the results is included.

4.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.236 // RSS-210 Annex G.3.1	Necessary BW Mask	18 Nov 2020

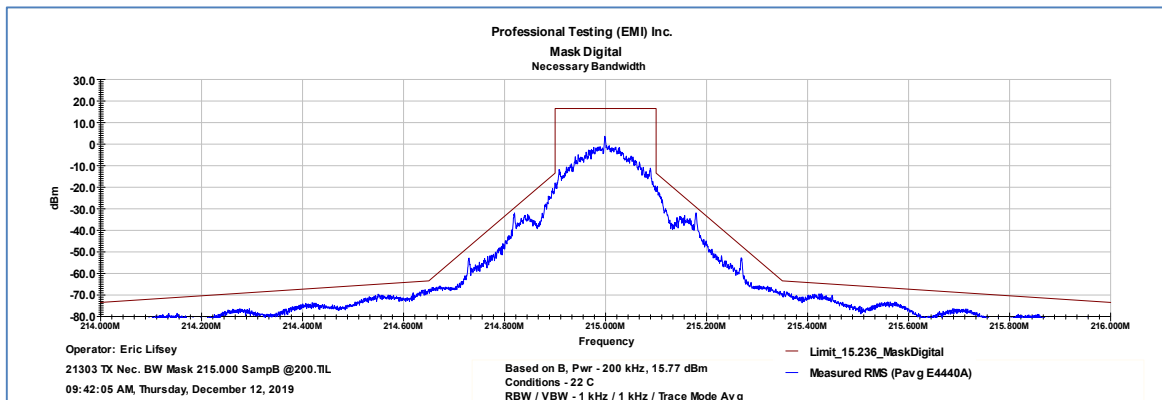
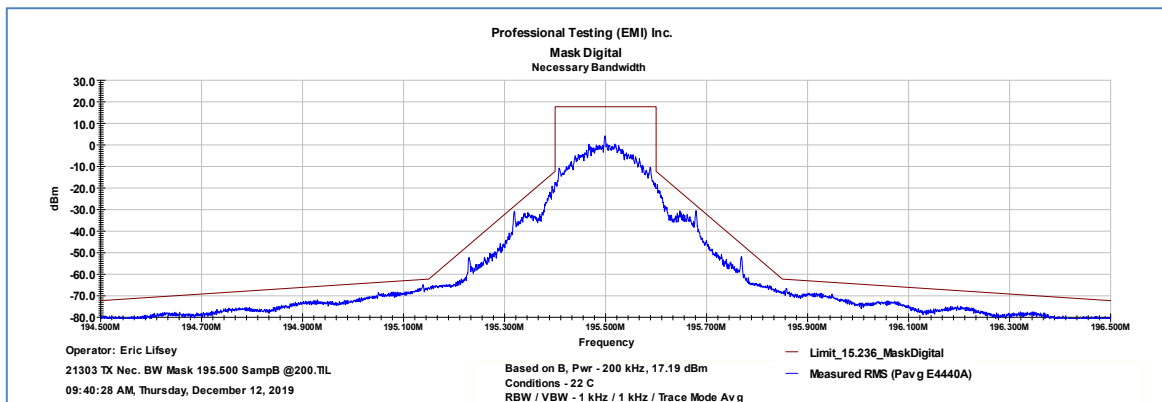
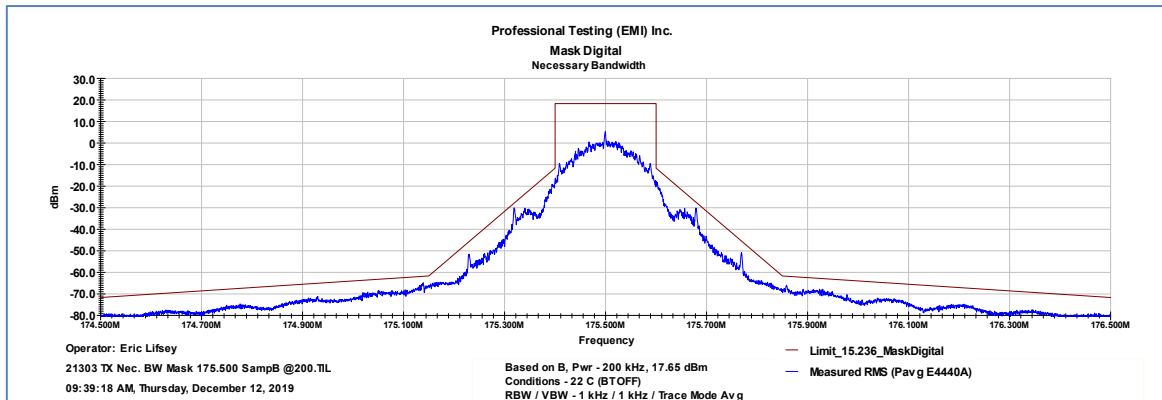
4.3 Test Results

The EUT was found to be in compliance with applicable requirements.

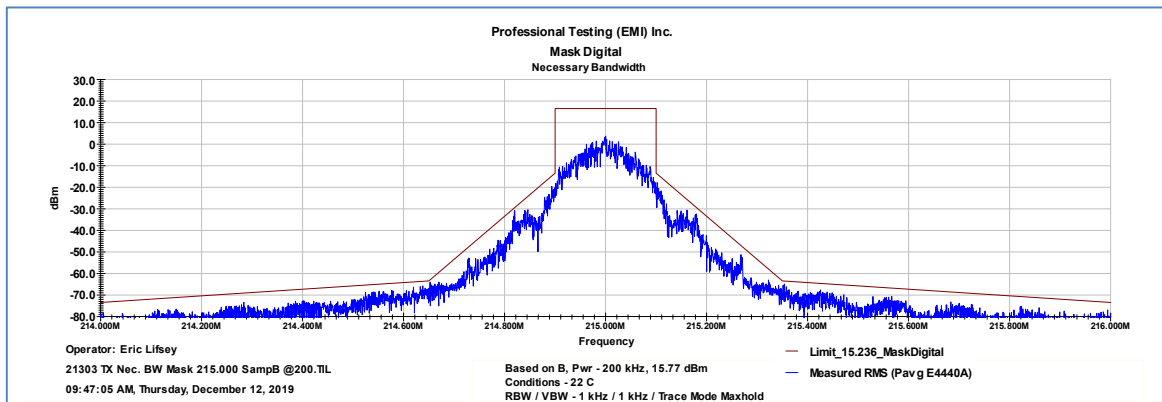
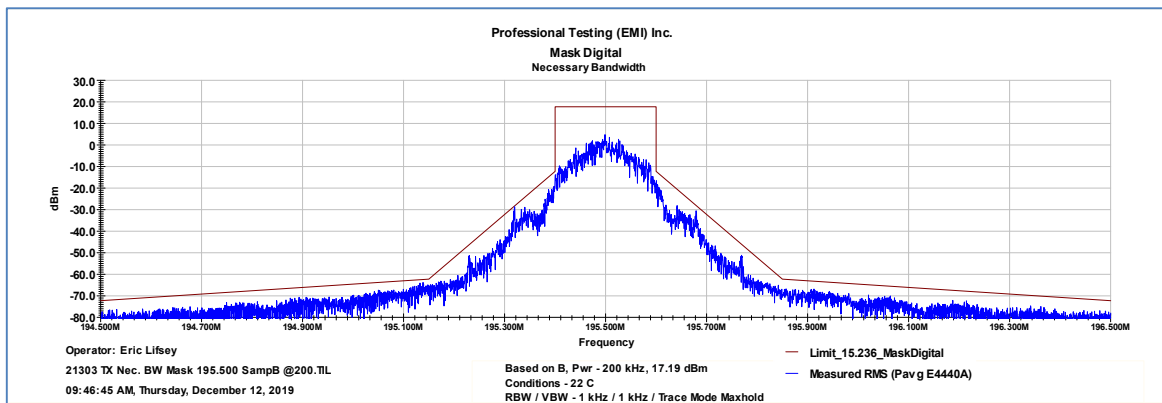
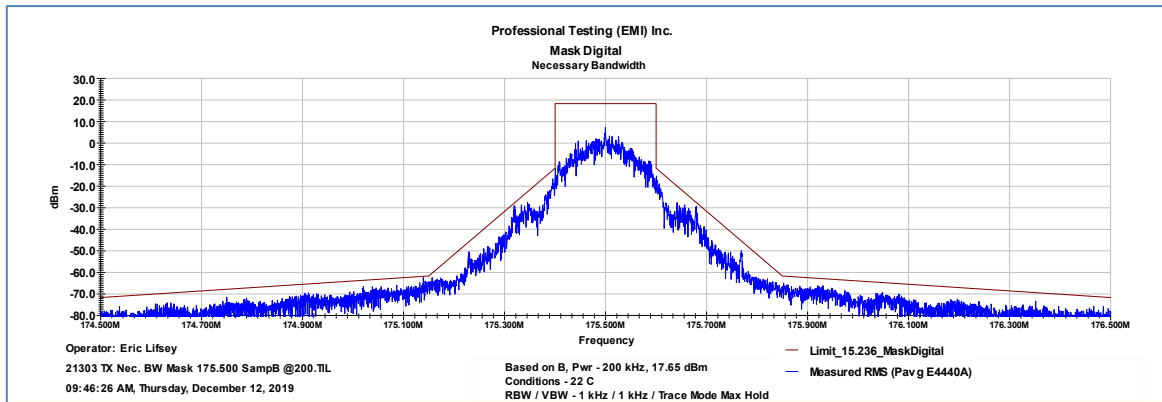
4.3.1 Step 1: Zero Span Power, Modulated

Table 4.3.1 Power in Zero Span with Modulation 20 Video Averages, Sweep Time 2 seconds, RBW/VBW 1 MHz		
Bottom Channel dBm	Middle Channel dBm	Top Channel dBm
17.65	17.19	15.77

4.3.2 Step 2: Mask, Average



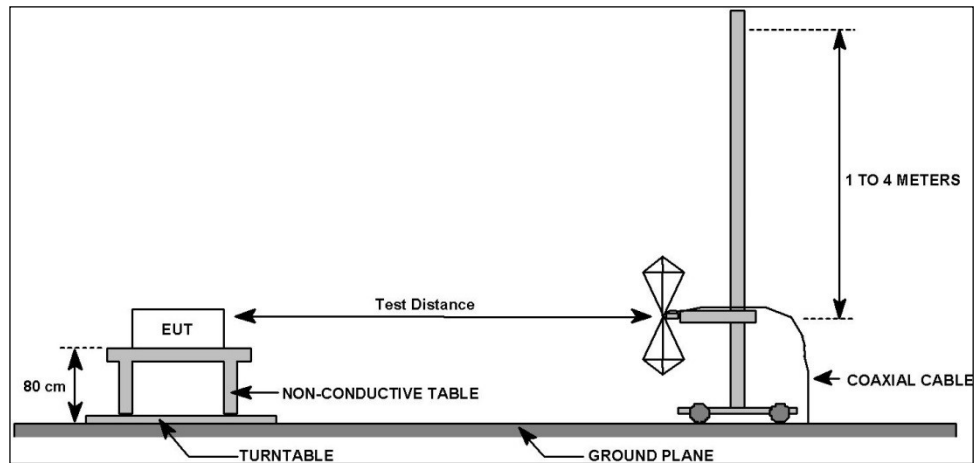
4.3.3 Step 3: Mask, Max Hold



5.0 Radiated Spurious Emissions, Transmit Mode

5.1 Test Procedure

Radiated emissions are measured with the EUT transmitting on the required frequencies.



6.1.1 Test Distance, Table Height, Detection Method

	30 MHz to 1 GHz	1 GHz and up
Distance	10 m	3 m
EUT Height	80 cm	1.5 m
Detection	Quasi-peak	Peak

5.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.236 // RSS-210 Annex G.3.1 (ETSI EN 300 422-1)	Field Strength of Radiated Spurious/Harmonic Emissions Transmit Mode	2 Feb 2020

5.3 Test Results

Three channels were tested. EUT was transmitting continuously.

The EUT satisfied the requirement. Graphical and tabular data appears below.

5.3.1 Bottom Channel

Professional Testing, EMI, Inc.

Test Method: ETSI EN 300 422-1
V1.4.2

In accordance with: FCC 15.236 referencing ETSI

Section: Transmit Spurious

Test Date(s): 2/4/2020

EUT Serial #: Sample G

Customer: Swimmersive

EUT Part #: 0

Project Number: 21303-15

Test Technician: Eric Lifsey

Purchase Order #: 0

Supervisor: Shakil Murad

Equip. Under Test: Coach

Witness' Name: Frank Dunn

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3.7 VDC

EUT Power: 0 N/A

Antenna Orientation: Vertical

Frequency Range: 30MHz to 1GHz

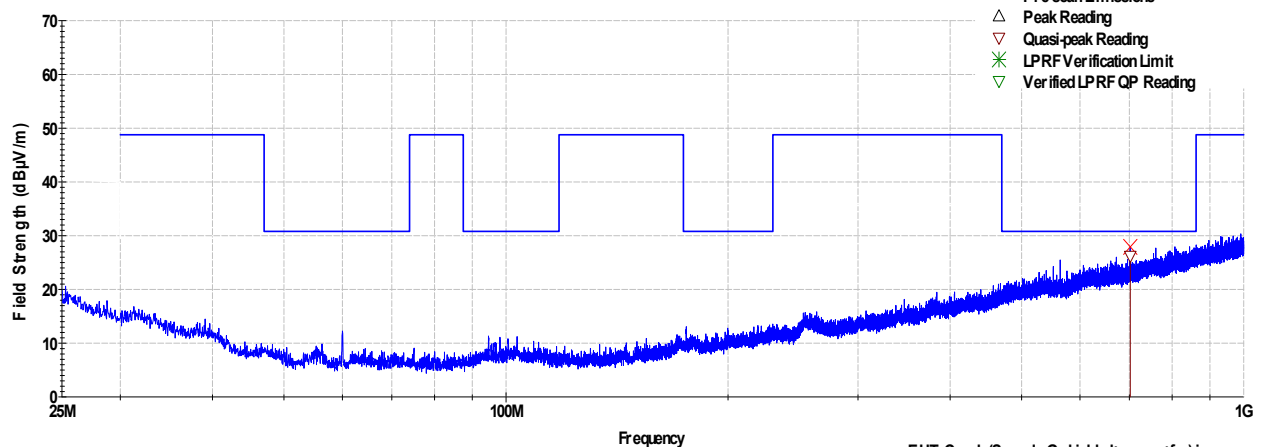
EUT Mode of Operation:

Transmit Bottom Chan

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
701.985	10	161	3.06	Quasi-peak	26.207	31.0	-4.8	Pass

Professional Testing, EMI, Inc

Radiated Emissions
30MHz - 1GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey

Current Time -11:59:15 AM, Tuesday, February 04, 2020

V_Mode: TX Bot Ch 175M5 BT_Mode: Off

Power: 3.7V Battery Notes: no antenna, in case

Setup: ETSI (150+150cm) (ferrite load cable)

EUT: Coach (Sample G shielded+copper+fer) in case.

Project Number: 21303

Client: Swimmersive Zygo

≤ 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ETSI EN 300 422-1
V1.4.2

In accordance with: FCC 15.236 referencing ETSI

Section: Transmit Spurious

Test Date(s): 2/4/2020

EUT Serial #: Sample G

Customer: Swimmersive

EUT Part #: 0

Project Number: 21303-15

Test Technician: Eric Lifsey

Purchase Order #: 0

Supervisor: Shakil Murad

Equip. Under Test: Coach

Witness' Name: Frank Dunn

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3.7 VDC

EUT Power: 0 N/A

Antenna Orientation: Horizontal

Frequency Range: 30MHz to 1GHz

EUT Mode of Operation:

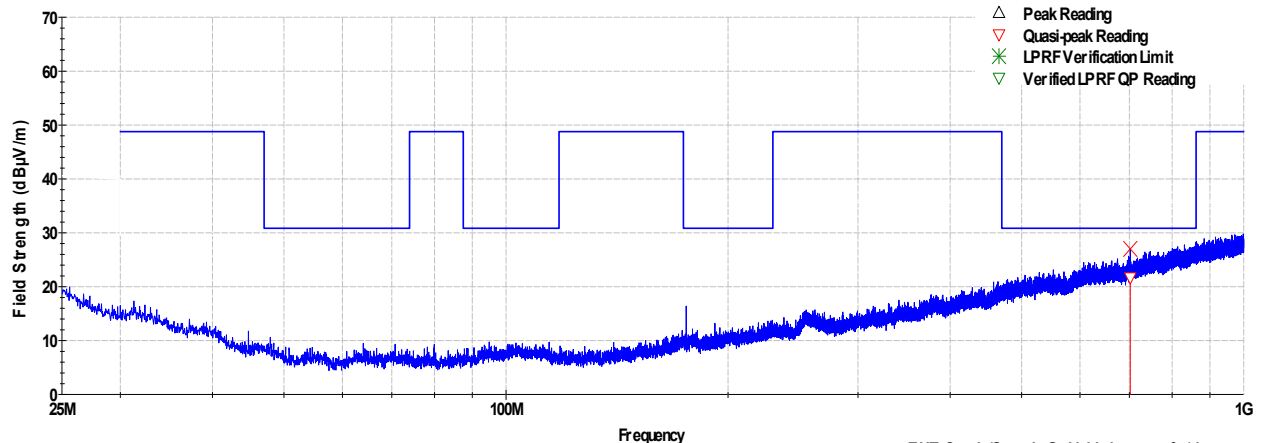
Transmit Bottom Chan

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
701.854	10	335	1.98	Quasi-peak	21.682	31.0	-9.3	Pass

Professional Testing, EMI, Inc

Radiated Emissions

30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

Current Time -12:02:25 PM, Tuesday, February 04, 2020

V_Mode: TX Bot Ch 175M5 BT_Mode: Off

Power: 3.7V Battery Notes: no antenna, in case

Setup: ETSI (150*150cm) (ferrite load cable)

EUT: Coach (Sample G shielded+copper+fer) in case.

Project Number: 21303

Client: Swimmersive Zygo

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ETSI EN 300 422-1
V1.4.2

In accordance with: FCC 15.236 referencing ETSI

Section: Transmit Spurious

Test Date(s): 2/4/2020

EUT Serial #: Sample G

Customer: Swimmersive

EUT Part #: 0

Project Number: 21303-15

Test Technician: Eric Lifsey

Purchase Order #: 0

Supervisor: Shakil Murad

Equip. Under Test: Coach

Witness' Name: Frank Dunn

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3.7 VDC

EUT Power: 0 N/A

Antenna Orientation: Vertical

Frequency Range: Above 1GHz

EUT Mode of Operation:

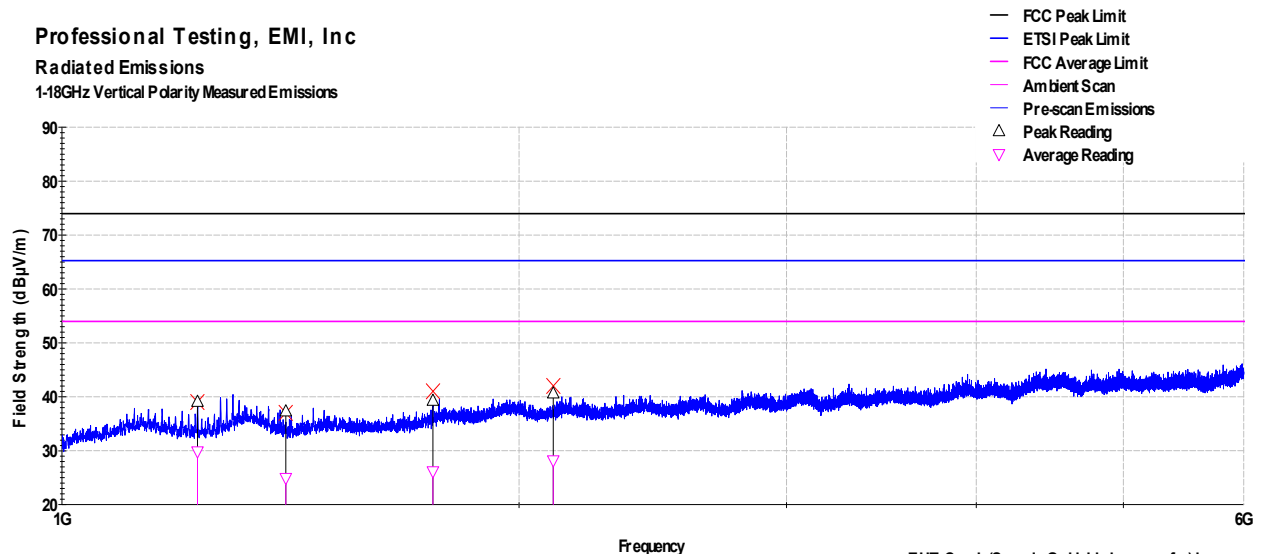
Transmit Bottom Chan

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
1228.15	3	321	1.79	Peak	39.066	65.0	-25.9	Pass
1404.21	3	149	1.68	Peak	37.308	65.0	-27.7	Pass
1755.04	3	3	2.85	Peak	39.267	65.0	-25.7	Pass
2106.45	3	268	2.88	Peak	40.628	65.0	-24.4	Pass

Professional Testing, EMI, Inc.

Radiated Emissions

1-18GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey

Current Time -11:33:43 AM, Tuesday, February 04, 2020

V_Mode: TX Bot Ch 175M5 BT_Mode: Off

Power: 3.7V Battery Notes: no antenna, in case

Setup: ETSI (150*150cm) (ferrite load cable)

EUT: Coach (Sample G shielded+copper+fer) in case.

Project Number: 21303

Client: Swimmersive Zygo

> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ETSI EN 300 422-1
V1.4.2

In accordance with: FCC 15.236 referencing ETSI

Section: Transmit Spurious

Test Date(s): 2/4/2020

EUT Serial #: Sample G

Customer: Swimmersive

EUT Part #: 0

Project Number: 21303-15

Test Technician: Eric Lifsey

Purchase Order #: 0

Supervisor: Shakil Murad

Equip. Under Test: Coach

Witness' Name: Frank Dunn

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3.7 VDC

EUT Power: 0 N/A

Antenna Orientation: Horizontal

Frequency Range: Above 1GHz

EUT Mode of Operation:

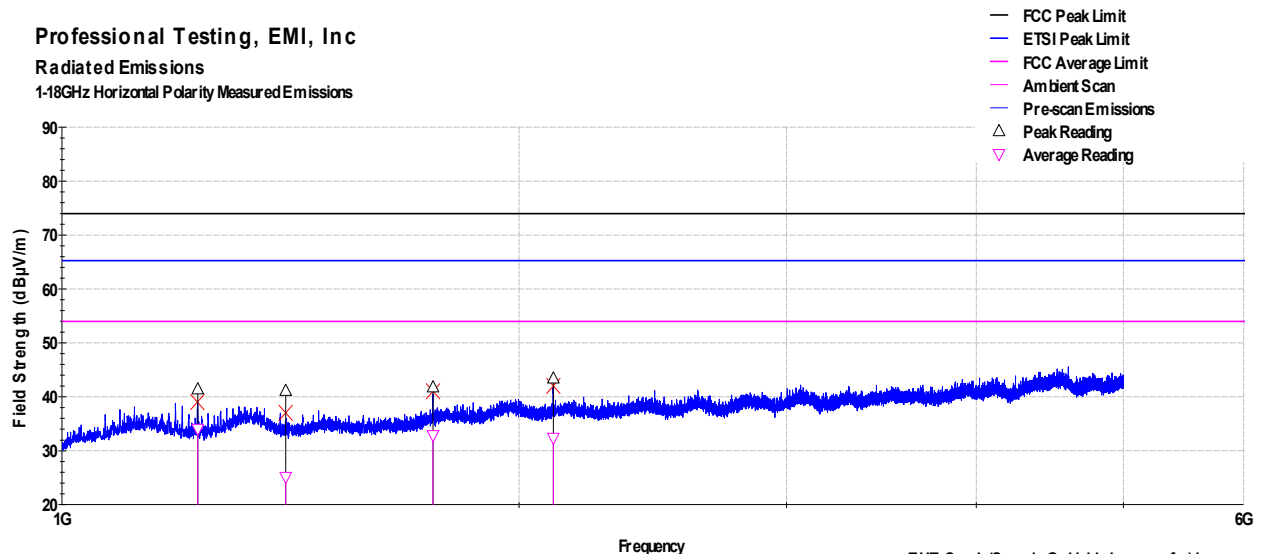
Transmit Bottom Chan

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
1228.8	3	203	2.85	Peak	41.4	65.0	-23.6	Pass
1403.97	3	15	2.49	Peak	41.1	65.0	-23.9	Pass
1755.26	3	220	2.96	Peak	41.751	65.0	-23.2	Pass
2106.66	3	340	2.85	Peak	43.399	65.0	-21.6	Pass

Professional Testing, EMI, Inc.

Radiated Emissions

1-18GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

Current Time -11:45:17 AM, Tuesday, February 04, 2020

V_Mode: TX Bot Ch 175M5 BT_Mode: Off

Power: 3.7V Battery Notes: no antenna, in case

Setup: ETSI (150x150cm) (ferrite load cable)

EUT: Coach (Sample G shielded+copper+fer) in case.

Project Number: 21303

Client: Swimmersive Zygo

> 1GHz Horizontal Antenna Polarity Measured Emissions

5.3.2 Middle Channel

Professional Testing, EMI, Inc.

Test Method: ETSI EN 300 422-1
V1.4.2

In accordance with: FCC 15.236 referencing ETSI

Section: Transmit Spurious

Test Date(s): 2/4/2020

EUT Serial #: Sample G

Customer: Swimmersive

EUT Part #: 0

Project Number: 21303-15

Test Technician: Eric Lifsey

Purchase Order #: 0

Supervisor: Shakil Murad

Equip. Under Test: Coach

Witness' Name: Frank Dunn

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3.7 VDC

EUT Power: 0 N/A

Antenna Orientation: Vertical

Frequency Range: 30MHz to 1GHz

EUT Mode of Operation:

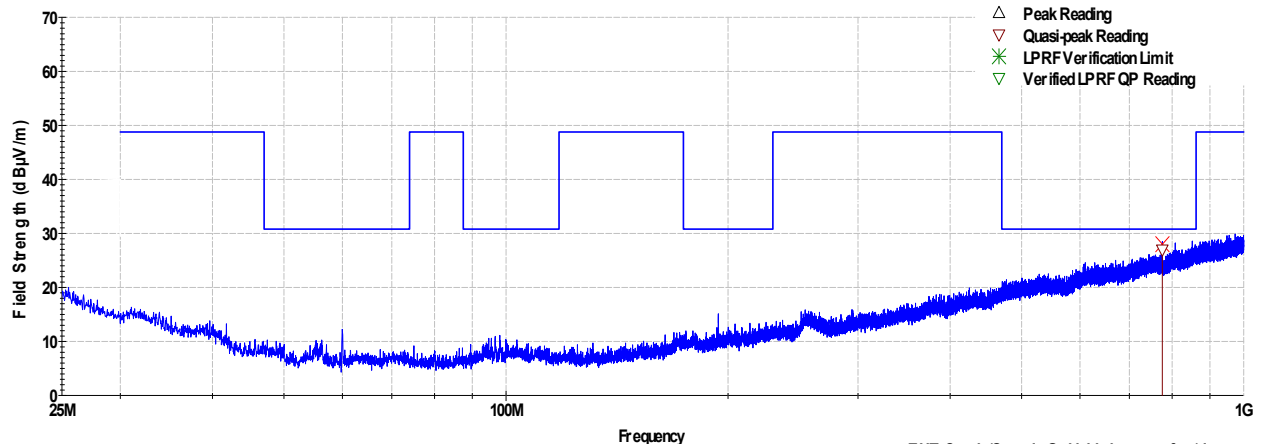
Transmit Middle Chan

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
775.852	10	206	1.43	Quasi-peak	26.983	31.0	-4.0	Pass

Professional Testing, EMI, Inc

Radiated Emissions

30MHz - 1GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey

Current Time -09:32:13 AM, Tuesday, February 04, 2020

V_Mode: TX Mid Ch 194M0 BT_Mode: Off

Power: 3.7V Battery Notes: no antenna, in case

Setup: ETSI (150+150cm) (ferrite on load)

EUT: Coach (Sample G shielded+copper+ferr) in case.

Project Number: 21303

Client: Swimmersive Zygo

≤ 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ETSI EN 300 422-1
V1.4.2

In accordance with: FCC 15.236 referencing ETSI

Section: Transmit Spurious

Test Date(s): 2/4/2020

EUT Serial #: Sample G

Customer: Swimmersive

EUT Part #: 0

Project Number: 21303-15

Test Technician: Eric Lifsey

Purchase Order #: 0

Supervisor: Shakil Murad

Equip. Under Test: Coach

Witness' Name: Frank Dunn

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3.7 VDC

EUT Power: 0 N/A

Antenna Orientation: Horizontal

Frequency Range: 30MHz to 1GHz

EUT Mode of Operation:

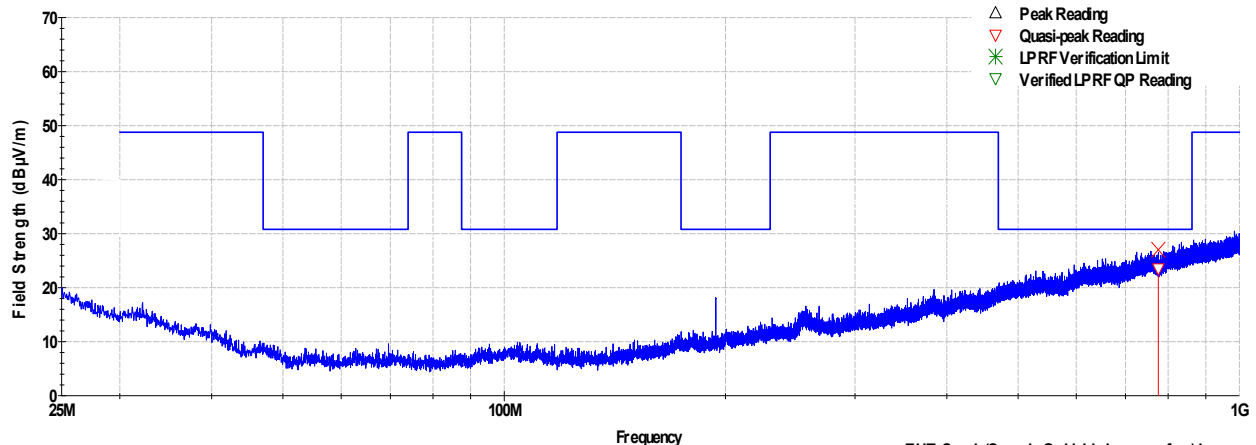
Transmit Middle Chan

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
775.861	10	205	3.29	Quasi-peak	23.521	31.0	-7.5	Pass

Professional Testing, EMI, Inc

Radiated Emissions

30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

Current Time: 09:32:37 AM, Tuesday, February 04, 2020

V_Mode: TX Mid Ch 194M0 BT_Mode: Off

Power: 3.7V Battery Notes: no antenna, in case

Setup: ETSI (150+150cm) (ferrite on load)

EUT: Coach (Sample G shielded+copper ferr) in case.

Project Number: 21303

Client: Swimmersive Zygo

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ETSI EN 300 422-1
V1.4.2

In accordance with: FCC 15.236 referencing ETSI

Section: Transmit Spurious

Test Date(s): 2/4/2020

EUT Serial #: Sample G

Customer: Swimmersive

EUT Part #: 0

Project Number: 21303-15

Test Technician: Eric Lifsey

Purchase Order #: 0

Supervisor: Shakil Murad

Equip. Under Test: Coach

Witness' Name: Frank Dunn

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3.7 VDC

EUT Power: 0 N/A

Antenna Orientation: Vertical

Frequency Range: Above 1GHz

EUT Mode of Operation:

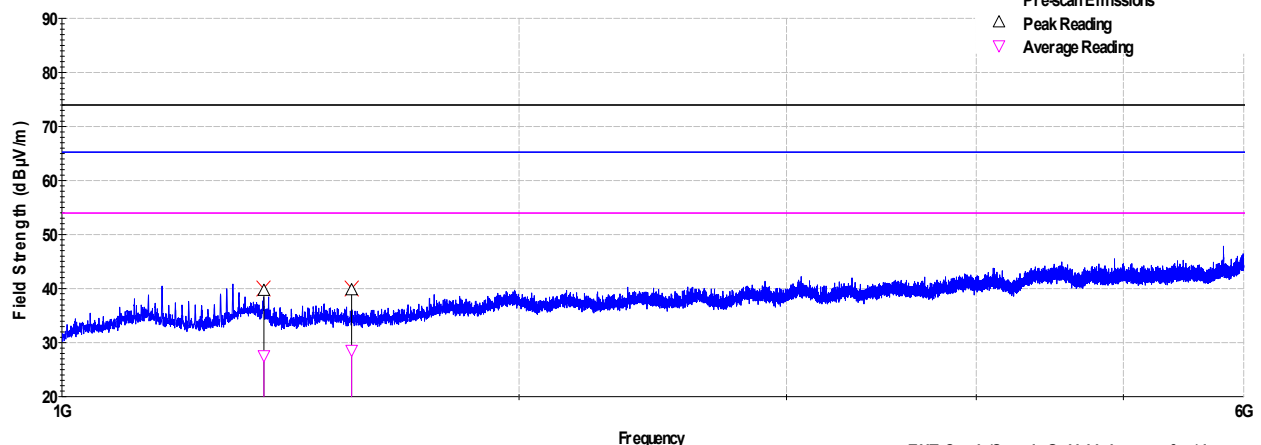
Transmit Middle Chan

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
1358.37	3	245	1.75	Peak	39.603	65.0	-25.4	Pass
1551.66	3	114	2.9	Peak	39.697	65.0	-25.3	Pass

Professional Testing, EMI, Inc

Radiated Emissions

1-18GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey

Current Time -11:05:52 AM, Tuesday, February 04, 2020

V_Mode: TX Mid Ch 194M0 BT_Mode: Off

Power: 3.7V Battery Notes: no antenna, in case

Setup: ETSI (150+150cm) (ferrite on load)

EUT: Coach (Sample G shielded+copper+ferr) in case.

Project Number: 21303

Client: Swimmersive Zygo

> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ETSI EN 300 422-1
V1.4.2

In accordance with: FCC 15.236 referencing ETSI

Section: Transmit Spurious

Test Date(s): 2/4/2020

EUT Serial #: Sample G

Customer: Swimmersive

EUT Part #: 0

Project Number: 21303-15

Test Technician: Eric Lifsey

Purchase Order #: 0

Supervisor: Shakil Murad

Equip. Under Test: Coach

Witness' Name: Frank Dunn

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3.7 VDC

EUT Power: 0 N/A

Antenna Orientation: Horizontal

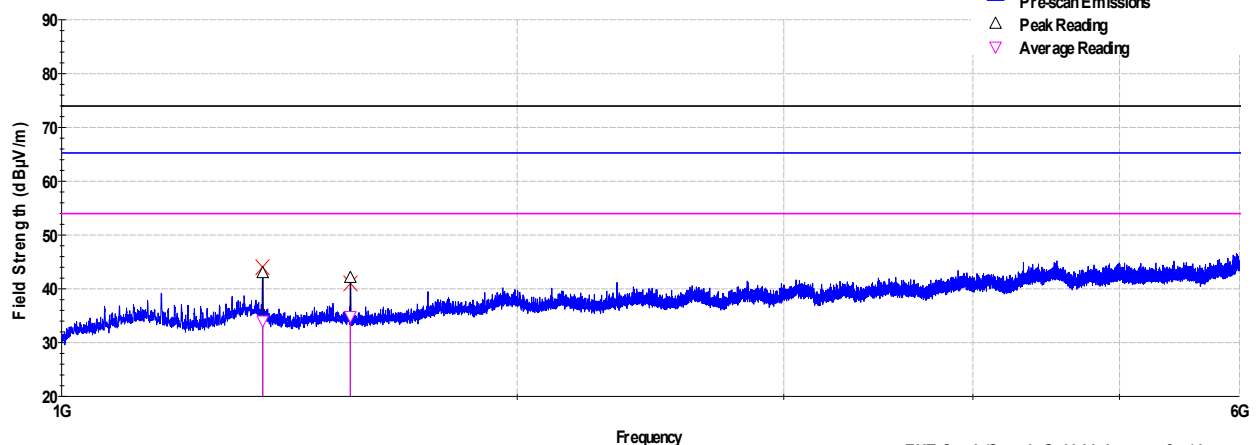
Frequency Range: Above 1GHz

EUT Mode of Operation:

Transmit Middle Chan

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
1357.95	3	3	1.74	Peak	42.927	65.0	-22.1	Pass
1551.66	3	41	2.95	Peak	42.038	65.0	-23.0	Pass

Professional Testing, EMI, Inc
Radiated Emissions
1-18GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

Current Time -11:05:12 AM, Tuesday, February 04, 2020

V_Mode: TX Mid Ch 194M0 BT_Mode: Off

Power: 3.7V Battery Notes: no antenna, in case

Setup: ETSI (150+150cm) (ferrite on load)

EUT: Coach (Sample G shielded+copper+ferr) in case.

Project Number: 21303

Client: Swimmersive Zygo

> 1GHz Horizontal Antenna Polarity Measured Emissions

5.3.3 Top Channel

Professional Testing, EMI, Inc.

Test Method: ETSI EN 300 422-1
V1.4.2

In accordance with: FCC 15.236 referencing ETSI

Section: Transmit Spurious

Test Date(s): 2/4/2020

EUT Serial #: Sample G

Customer: Swimmersive

EUT Part #: 0

Project Number: 21303-15

Test Technician: Eric Lifsey

Purchase Order #: 0

Supervisor: Shakil Murad

Equip. Under Test: Coach

Witness' Name: Frank Dunn

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3.7 VDC

EUT Power: 0 N/A

Antenna Orientation: Vertical

Frequency Range: 30MHz to 1GHz

EUT Mode of Operation:

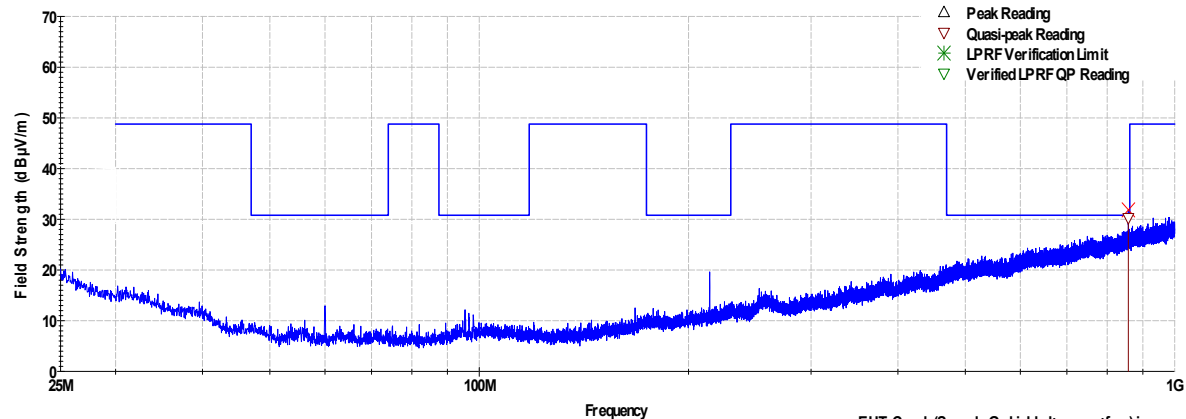
Transmit Top Chan

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
857.83	10	4	1.42	Quasi-peak	30.268	31.0	-0.7	Pass

Professional Testing, EMI, Inc

Radiated Emissions

30MHz - 1GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey

Current Time: 10:04:43 AM, Tuesday, February 04, 2020

V_Mode: TX Top Ch 214M5 BT_Mode: Off

Power: 3.7V Battery Notes: no antenna, in case

Setup: ETSI (150+150cm) (ferrite on load)

EUT: Coach (Sample G shielded+copper+ferr) in case.

Project Number: 21303

Client: Swimmersive Zygo

≤ 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ETSI EN 300 422-1
V1.4.2

In accordance with: FCC 15.236 referencing ETSI

Section: Transmit Spurious

Test Date(s): 2/4/2020

EUT Serial #: Sample G

Customer: Swimmersive

EUT Part #: 0

Project Number: 21303-15

Test Technician: Eric Lifsey

Purchase Order #: 0

Supervisor: Shakil Murad

Equip. Under Test: Coach

Witness' Name: Frank Dunn

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3.7 VDC

EUT Power: 0 N/A

Antenna Orientation: Horizontal

Frequency Range: 30MHz to 1GHz

EUT Mode of Operation:

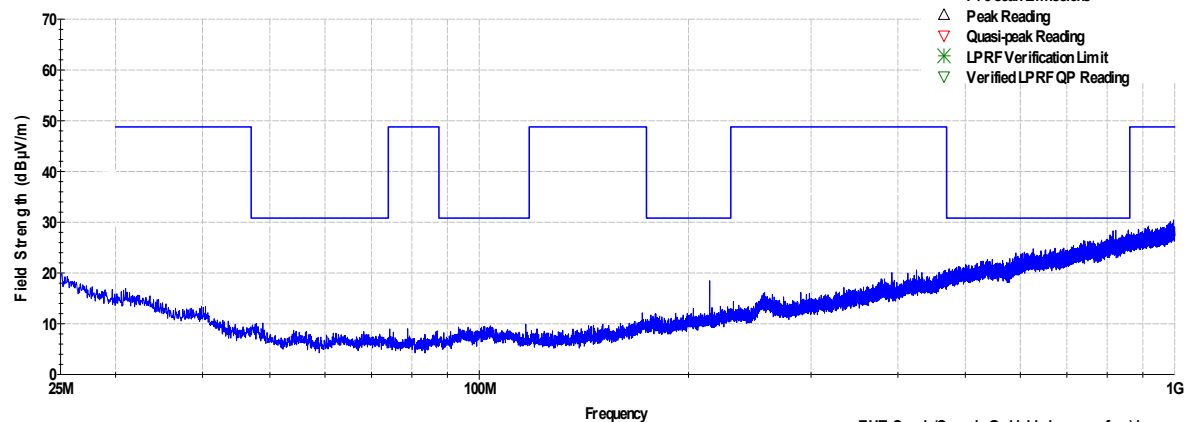
Transmit Top Chan

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
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Professional Testing, EMI, Inc

Radiated Emissions

30MHz - 1GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

Current Time: 10:04:51 AM, Tuesday, February 04, 2020

V_Mode: TX Top Ch 214M5 BT_Mode: Off
Power: 3.7V Battery Notes: no antenna, in case
Setup: ETSI (150+150cm) (ferrite on load)

EUT: Coach (Sample G shielded+copper+ferr) in case.

Project Number: 21303

Client: Swimmersive Zygo

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ETSI EN 300 422-1
V1.4.2

In accordance with: FCC 15.236 referencing ETSI

Section: Transmit Spurious

Test Date(s): 2/4/2020

EUT Serial #: Sample G

Customer: Swimmersive

EUT Part #: 0

Project Number: 21303-15

Test Technician: Eric Lifsey

Purchase Order #: 0

Supervisor: Shakil Murad

Equip. Under Test: Coach

Witness' Name: Frank Dunn

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3.7 VDC

EUT Power: 0 N/A

Antenna Orientation: Vertical

Frequency Range: Above 1GHz

EUT Mode of Operation:

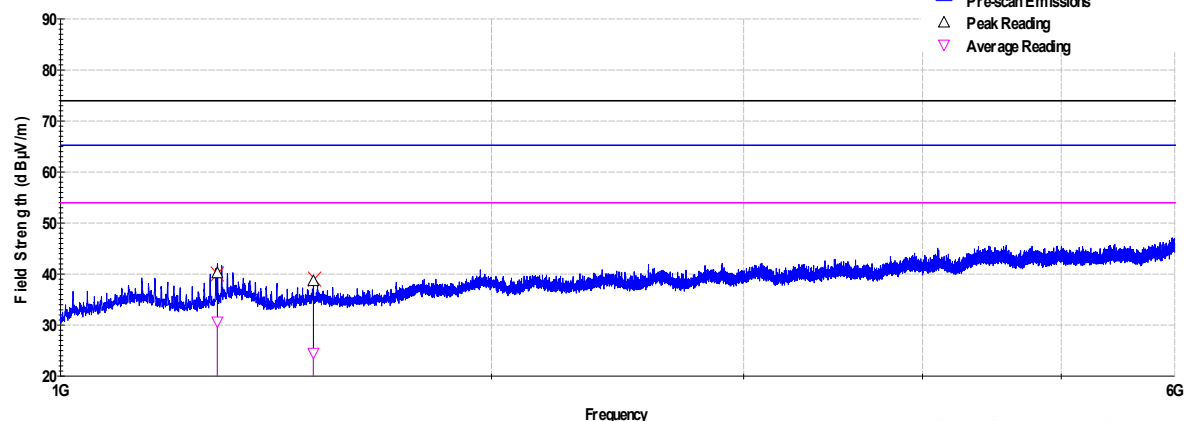
Transmit Top Chan

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
1287	3	3	1.96	Peak	40.141	65.0	-24.9	Pass
1501.88	3	85	2.95	Peak	38.588	65.0	-26.4	Pass

Professional Testing, EMI, Inc

Radiated Emissions

1-18GHz Vertical Polarity Measured Emissions



Operator: Eric Lifsey

Current Time: 10:28:40 AM, Tuesday, February 04, 2020

V_Mode: TX Top Ch 214M6 BT_Mode: Off

Power: 3.7V Battery Notes: no antenna, in case

Setup: ETSI (150+150cm) (ferrite on load)

EUT: Coach (Sample G shielded+copper+ferr) in case.

Project Number: 21303

Client: Swimmersive Zygo

> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

Test Method: ETSI EN 300 422-1
V1.4.2

In accordance with: FCC 15.236 referencing ETSI

Section: Transmit Spurious

Test Date(s): 2/4/2020

EUT Serial #: Sample G

Customer: Swimmersive

EUT Part #: 0

Project Number: 21303-15

Test Technician: Eric Lifsey

Purchase Order #: 0

Supervisor: Shakil Murad

Equip. Under Test: Coach

Witness' Name: Frank Dunn

Radiated Emissions Test Results Data Sheet

EUT Line Voltage: 3.7 VDC

EUT Power: 0 N/A

Antenna Orientation: Horizontal

Frequency Range: Above 1GHz

EUT Mode of Operation:

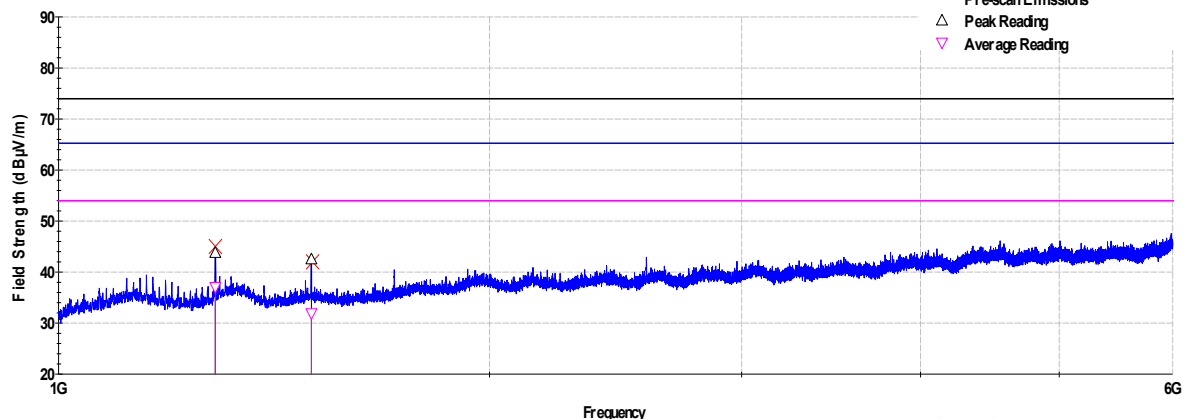
Transmit Top Chan

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
1286.65	3	240	1.84	Peak	-30.241	65.0	-95.2	Pass
1501.69	3	27	2.92	Peak	-31.487	65.0	-96.5	Pass

Professional Testing, EMI, Inc

Radiated Emissions

1-18GHz Horizontal Polarity Measured Emissions



Operator: Eric Lifsey

V_Mode: TX Top Ch214M6 BT_Mode: Off

EUT: Coach (Sample G shielded+copper+ferr) in case.

Current Time: 10:27:58 AM, Tuesday, February 04, 2020

Power: 3.7V Battery Notes: no antenna, in case

Project Number: 21303

Setup: ETSI (150+150cm) (ferrite on load)

Client: Swimmersive Zygo

> 1GHz Horizontal Antenna Polarity Measured Emissions

6.0 Antenna Construction

6.1 Procedure

A direct examination of the antenna construction is performed and compared to rule criteria that prevent wireless device antennas from being modified by end users.

6.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.203 // RSS-Gen 8.3	Antenna Construction	29 Apr 2020

6.3 Results

Table 8.3.1 Antenna Construction Details
Manufacturer: Swimmersive Part Number: N/A Type: Inductively/helical loaded monopole curved to fit enclosure. Gain: -5.5 dBi peak Construction: No connector provided. Antenna is internal to device and not subject to user modification.

The antenna system design above satisfies the requirements of the rules.

7.0 Equipment

7.1 Radiated Emissions

Radiated Emissions Test Equipment List					
Tile! Software Version:		Version: 7.1.2.17 (Jan 08, 2016 - 02:12:48 PM) or 4.1.A.0, April 14, 2009, 11:01:00PM			
Test Profile:		2019_May_Unintentional RE_TILE7_v2.5.til			
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	TDK 10M	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	9/17/2021
1890	HP	8447F-H64	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	1/9/2022
1937	Agilent	E4440A - AYZ	PSA , 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	11/8/2020
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	3/11/2021
C027	none	RG214	Cable Coax, N-N, 25m, 25MHz - 1GHz	None	9/9/2020
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	Braden	TDK 10M	TDK 10M Chamber, sVSWR > 1 GHz	DAC-012915-005	9/21/2021
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, 100MHz-18GHz	None	1/9/2022
C030	none	none	Cable Coax, N-N, 30m, 1 - 18GHz	None	9/9/2020
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	3/11/2021

7.2 Fundamental Power, Bandwidth, Duty Cycle, Mask, Conducted Spurious

Asset #	Manufacturer	Model #	Description	Calibration Due
1937	Agilent	E4440A	Spectrum Analyzer	8 Nov 2020

8.0 Measurement Bandwidths

Radiated Emissions Spectrum Analyzer Bandwidth and Measurement Time - Peak Scan				
Frequency Band Start (MHz)	Frequency Band Stop (MHz)	6 dB Bandwidth (kHz)	Number of Ranges Used	Measurement Time per Range
0.009	0.15	0.3	2	Multiple Sweeps
0.15	30	9	6	Multiple Sweeps
30	1000	120	2	Multiple 800 mS Sweeps
1000	6000	1000	2	Multiple Sweeps
6000	18000	1000	2	Multiple Sweeps
18000	26500	1000	2	Multiple Sweeps
*Notes: 1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range. 2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz. 3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz. 4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz. 5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.				

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1: Summary of Measurement Uncertainties for Site 45

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Mains Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	2.8
Radiated Emissions	30 to 1,000 MHz	10 m	4.8
	1 to 18 GHz	3 m	5.7

End of Report